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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/966,923	09/28/2001	Zhijian Lu	01 P 14628 US (8055-108)	5067

7590 05/10/2004

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EXAMINER	
SODERQUIST, ARLEN	
ART UNIT	**PAPER NUMBER**
1743	

DATE MAILED: 05/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/966,923	Applicant(s) LU ET AL.	
	Examiner Arlen Soderquist	Art Unit 1743	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 January 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-6 and 8-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-6 and 8-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 February 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

2. Claims 1-2, 4-6 and 8-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett (US 4,675,072) in view of Agarwal (US 6,323,046). In the patent Bennett teaches detection of a trench etch endpoint by laser induced fluorescence. Laser induced fluorescence (LIF) is utilized to detect and control the reactive ion etch-through of a given layer in a wafer by detecting a large change in the concentration of a selected minor species from the wafer in the etching plasma. As an example, CuCl generated (formed) from Cu dopant can be monitored in the plasma by LIF detection of its particular laser transition line. An electrical signal is indicative of the CuCl concentration in the plasma, and when the amplitude of this signal falls below a predetermined level, the given layer of the wafer, present in a reaction chamber, is considered to be etched through and the process is halted. Example 3 detects the presence of aluminum from studs that are set in the silicon dioxide layer. Column 1 lines 26-60 teach that one problem encountered in the use of reactive ion etching is the insufficient reproducibility of the etching rate. This etch reproducibility problem may be caused by variations in the plasma composition due to the time dependent presence of etch products, difficulties in completely controlling the surface temperature of the wafer or wafers to be etched, and batch-to-batch variation in the quantity of material to be etched, or the load. Because of this variation in the etching rate, reactive ion etching in many cases requires monitoring to detect the completion of the etching process. In this regard, it is important to detect end of the etching process in order to

terminate the etch before over-etching occurs in the sublayer below the layer being etched. Such over etching is detrimental not only because it attacks the substrate or sublayer below the layer being etched, but also because it causes undercutting of the etch pattern, thereby altering the dimensions of the desired features in the etched layer. One typical endpoint detection method monitors a majority chemical species from the layer being etched. The time to terminate the process is inferred from changes in the intensity of this monitored majority species spectral line. The monitoring of the majority species coming from the etched layer works well in many situations where the etched layer and the sublayer therebelow are composed of different materials. However, when the composition of the etched layer and its sublayer therebelow are similar or the same, then monitoring of the majority species from the etched layer will not provide a determination of the etch endpoint. Bennett does not teach an implanted layer for endpoint detection of the use of a mass spectrometer.

In the patent Agarwal teaches method and apparatus for endpointing a chemical-mechanical planarization (CMP) process. Column 2, lines 4-21 teach that the throughput of CMP processing is a function of several factors, one of which is the ability to accurately stop CMP processing at a desired endpoint. In a typical CMP process, the desired endpoint is reached when enough material has been removed from the substrate to form discrete components on the substrate (e.g., shallow trench isolation areas, contacts, damascene lines, etc.). Accurately stopping CMP processing at a desired endpoint is important for maintaining a high throughput because the substrate may need to be re-polished if the substrate is "under-planarized." Accurately stopping CMP processing at the desired endpoint is also important because too much material can be removed from the substrate, and thus the substrate may be "over-polished." Thus, it is highly desirable to stop CMP processing at the desired endpoint. The method and apparatus for endpointing a planarization process of a microelectronic substrate may include a species analyzer that receives a slurry resulting from the planarization process and analyzes the slurry to determine the presence of an endpointing material implanted beneath the surface of the microelectronic substrate. The species analyzer may include a mass spectrometer or a spectrum analyzer. The apparatus may alternatively include a radiation source that directs impinging radiation toward the microelectronic substrate, exciting atoms of the substrate, which in turn produce an emitted radiation. A radiation detector is positioned proximate to the substrate to

receive the emitted radiation and determine the endpoint by determining the intensity of the radiation emitted by the endpointing material. The endpointing material may be selected to be easily detected by the species detector or the radiation detector, and may further be selected to be easily distinguishable from a matrix material that comprises the bulk of the microelectronic substrate. The mass spectrometer is discussed on column 5, lines 21-45 and the spectrum analyzer is discussed of lines 46-60 of the same column. Column 6 lines 31-37, the endpointing material is taught as tungsten, aluminum, copper, or any material that can be distinguished from the matrix material such as any non-silicon compound or element when the matrix material includes any silicon compound. Column 3, lines 1-13, describe a prior method in which a change in material is detected as the process passes from one layer to the next. Columns 6-8 give specifics relative to the formation of the detection layer(s) by implanting the endpointing material into the substrate at a defined/selected depth below the surface (see column 6, line 50 – column 7, line 21). They also cover how the process endpoint is determined relative to the detection of the endpointing material. In particular figures 3B, 4B and 5B show shapes of concentration profiles of the endpoint material during the process for a variety of substrates shown in figures 3A, 4A and 5A. columns 7-8 teach how these profiles or the peaks in these profiles can be used to determine when to halt the process. Column 7, line 53 to column 8, line 13 teach various advantages of the method including the process being accurately halted after material has been removed from a generally homogeneous microelectronic substrate, the method using a small amount of endpointing material compared to some conventional methods, determining the endpoint in situ, without removing the substrate from the apparatus or otherwise interrupting or affecting the planarizing process, selecting the position of the endpoint by controlling the depth at which the endpointing material is deposited in the substrate, and manufacturing the microelectronic substrate with several layers, each positioned at a different depth beneath the surface resulting from the topography of the surface, or alternatively, by controlling the implanting process to position each layer at a selected depth beneath the surface allowing one of the layers to be selected to correspond to the desired endpoint.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the mass spectrometer of Agarwal for the detection device of Bennett because both references are dealing with a similar problem – detecting the endpoint of a material

removal process used in the semiconductor industry on a microelectronic substrate – and the teaching of equivalence between the mass spectrometry method and the optical method by Agarwal in an in situ process to detect an end point detecting material in order to halt the material removing process. It would also have been obvious to one of ordinary skill in the art to implant the end point detecting material in the matrix material as taught by Agarwal because of the reasons above and the ability to set the depth of endpoint material and accurately select the point at which the process is halted as taught in the advantages of Agarwal.

3. Applicant's arguments filed January 14, 2004 have been fully considered but they are not persuasive. Relative to the combination of references examiner points to the fact that both references are concerned with a similar problem -- the detection of the point at which a material removal process should be halted in a processes used in the preparation of microelectronic devices by analysis of a dopant present in the microelectronic substrate. Even though the two material removal process are different, this clearly ties the two references together since that are dealing with a problem that is common to both. As a result of this, the teachings of Agarwal clearly would have given an expectation of obtaining the advantages taught by Agarwal by applying the techniques to the Bennett process. Relative to the Bennett reference, it is clear that the analyzed component is a dopant in the material that is to be removed. This is analogous to the conventional method described by Agarwal in column 7, lines 57-63 for which Agarwal teaches that the implanted method uses a small amount of endpointing material. Thus based on this alone one of skill in the art would recognize that one advantage of the Agarwal method is the amount of dopant needed. Additionally the other advantages taught in that section of the disclosure (column 7, line 53 to column 8, line 13) would also have been recognized as advantages in replacing the dopant of Bennett with the implanted dopant of Agarwal. Also it is clear that halting the material removal process in Agarwal is clearly dependent on the detection of a peak concentration of the dopant. This may be seen in both the ability to select the depth that the dopant is added in the implanting process and the use multiple layers to control when the process is halted.

4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arlen Soderquist whose current telephone number is (571) 272-1265 as a result of the examiner moving to the new USPTO location. The examiner's schedule is variable between the hours of about 5:30 AM to about 5:00 PM on Monday through Thursday and alternate Fridays.

A general phone number for the organization to which this application is assigned is (571) 272-1700. The fax phone number to file official papers for this application or proceeding is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Arlen Soderquist
May 6, 2004

ARLEN SODERQUIST
PRIMARY EXAMINER